

TC - PT100

Temperature Controller For Dry Type Medium Voltage Transformers



Introduction

Developed for winding temperature control of resin or dry type MV transformers. It is based on high level electromagnetic interference, also standardized. There are 4 PT100 sensor inputs. The transformer core temperature or the ambient temperature can also be measured from the 4th sensor input if the 3-phase transformer requests the winding temperatures individually as well as it can be measured. There are 4 relay outputs, ALARM, FAULT, TRIP and FAN.

The design, hardware and software were entirely made by KAELE engineers.

The state-of-the-art technology has been incorporated into this device and features have been added that make it easier for the user to use both menus and features. The device has a color LCD display (TFT). As a memory, the device has its own recording area and records error reports.

All information and warnings that you need to know about the device are described in the user manual. Please read this booklet carefully before commissioning your system and your own safety equipment. Please do not make anything about the topics that are not being understood without making any contact with our company.

Tel: 0.232.877 14 84 (pbx) **Fax:** 0.232.877 14 49

Factory: Ataturk Mah. 78 Sok. No:10 Ulucak Village, Kemalpaşa - İZMİR.



Warning

- 1- The device must be commissioned and programmed by authorized and qualified persons in accordance with the instructions in the operating instructions. If necessary, they should also be inspected by these persons.
- 2- Do not open the device, do not make it opened. There are no serviceable parts inside the device that any other user or person will intervene.
- 3- Use the device in accordance with installation instructions
- 4- Before making electrical connections to the terminals of the device, make sure that there is no energy in the cables and terminals. There should not be energy in the panel.
- 5- The fuses to be used in the device must be 1A FF type.
- 6- Secure the appliance firmly so that it does not swing to the panel with the appliances supplied.
- 7- Do not interfere of the keys on the front panel of the device with anything other than your fingers.
- 8- Once you are sure that you have cut off your device, wipe it with dry cloth only. Chemicals used in water or cleaning shall damage the device.
- 9- Make sure that the terminal connections are made in accordance with the connection diagram and not in contact (loose connection or interconnection of multiple copper wires, etc.) before the device is switched on (before energization).
- 10- The above precautions and warnings are for your safety. In case of non-compliance, KAELE Elektronik Ltd. Sti. or vendors are not responsible.

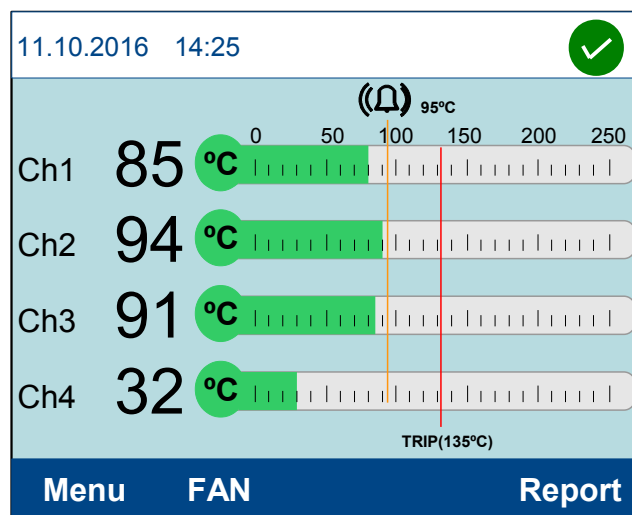
Features

- 24 - 240 Vac - Vdc 50/60Hz ultra wide feed input
- Easy menu design with Turkish, English and Russian language support
- Color LCD display (320 x 240 pixel x 2.4 ")
- Built on embedded system and working on operating system
- It has 4 Pt100 (3-Wires) RTD sensor inputs
- Sensor inputs are resistant to electromagnetic interference
- Cable lengths in Pt100 are not included in the calculation
- It measures temperature between -10°C and 250°C and has $\pm 1\%$ measurement accuracy
- 1 ALARM relay output
- 1 TRIP relay output
- There is a relay output (FAULT) for errors in one device operation
- 1 FAN relay output for cooling
- The alarms and faults received by the device are stored in the device memory (the last 40 records)
- 3VA supply available
- Intelligent Fan operation and stop algorithm saves energy in transformer cooling
- Continuously monitors temperature sensors for faults.
It detects errors "Sensor cable is broken",
"Sensor cable short circuit"
"Sensor not attached"
- Error detection in case of data recording center failure
- Password Protection protects the Settings menu against unauthorized users
- There is a button for making the alarm silent or for Manual Fan control

General

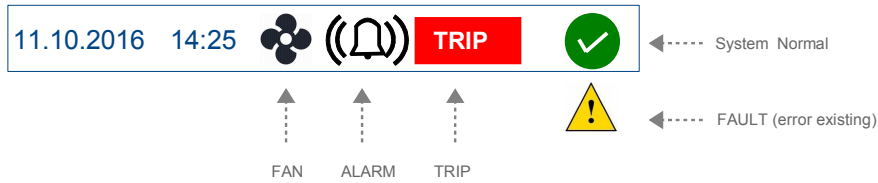
The device that is developed to protect the windings of MV transformers and high-power motors equipped with today's technology, is quite well equipped in terms of function richness and has added a new product to its sector with its advanced software. Additionally, the microprocessor inside is very fast and uses the operating system. This ensures that all operations can be synchronized simultaneously.

Displaying the error and temperature values that may occur on the main screen during device operation is as follows.



Information Panel

The upper part of the screen of the device has an information panel consisting of icons easily understood by the user. This panel is always on top of the screen no matter which part the user is in. The date, time, device operation status, FAULT status, ALARM status, TRIP status, FAN status information are observed in this panel at the same time. The operating status indicator indicates OK if the system is normal and returns to exclamation point when an error occurs in the system.



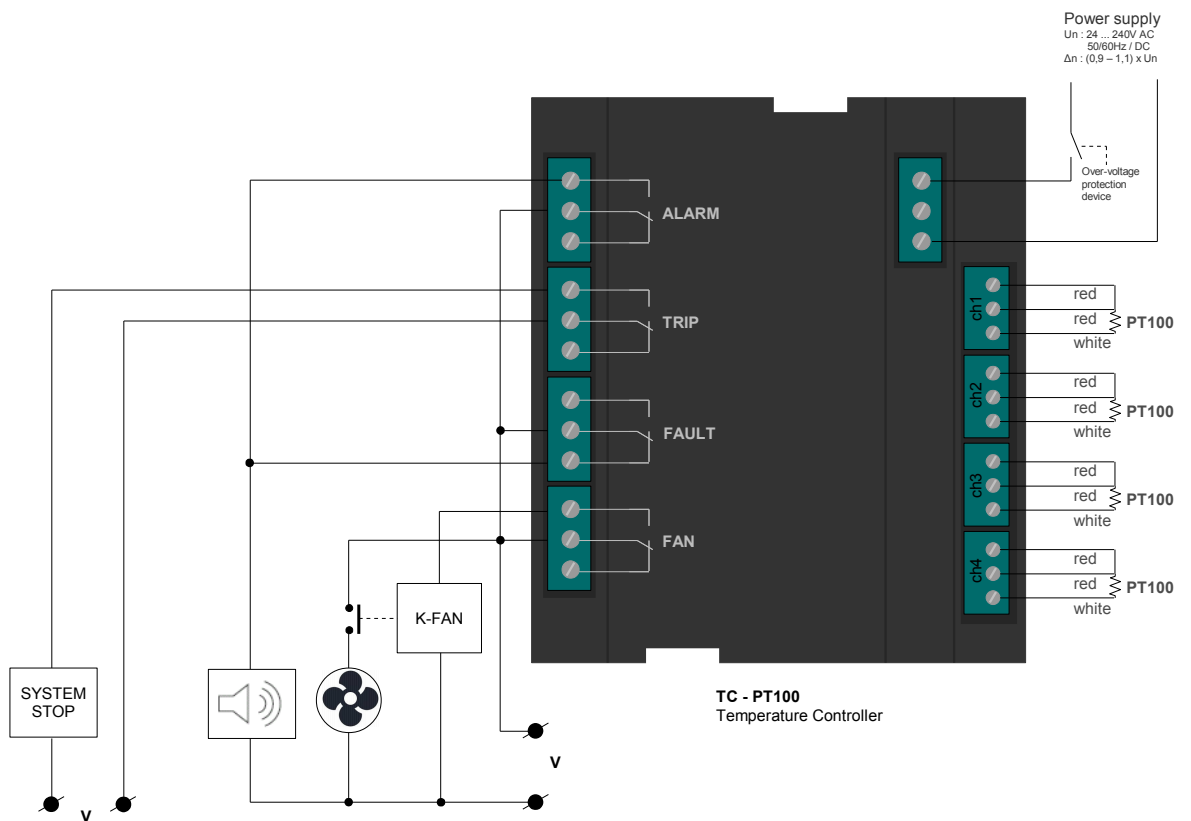
The fan icon turns on the screen while the fan is running.
If the screen shows a fan but does not turn, then the unit has gone into a saving mode for cooling.



A color LCD display is used in our device to make it much easier and clearer to use. If the keys are not pressed for a long time, the device will switch to screen saver mode to extend the life of the screen and only step down from the top of the screen with the information panel on top. When any key is pressed, the main screen image appears again.

Making Connections

- The connection of the device should be done without the system power.
- The device must be connected as shown in the connection diagram.
- Do the Pt100 sensor inputs as shown on the back of the unit
- Do not energize the device without checking all connections using the meter.



Supply Unit

TC - PT100 has a very wide operating voltage range. It can operate in the range of 24 - 240 Vac, 50/60 Hz.



If the supply of the device is taken directly from the output of the transformer (230V AC), when the transformer is switched off by one of the MV fuses or when the transformer is operated without a load with a fixed capacitor used to rectify the power factor, high voltage may be applied to the supply of the device and the device supply may be damaged.

To ensure that the TC-PT100 control unit operates correctly and safely, and to avoid being affected by high line voltage, we recommend you to use the device with external 24 Vdc or use the device supply with an overvoltage protection relay (ADG3X).



To prevent serious damage to the device, the supply input of the device must be switched on before performing the insulation test of the electrical panel.

Alarms and Fan Activity

ALARM and TRIP relays are energized only when they exceed the set temperature values.

After the device is switched on, the FAULT relay is energized and the relay is de-energized if one of the following conditions occurs:

- Failure of storage memory in the device
- Pt100 sensor faults ("Open Circuit, Short Circuit, ΔT Instantaneous Temperature Increase")
- When there is insufficient feed input
- If it is returned to Factory Settings during operation

The FAN relay output must be connected to the cooling fan or the air cooling system in the room where the traction is located.



NOTE-1: Do not connect the FAULT relay output to the tripping circuit of the MV Transformer.

NOT-2: Disconnect the power before changing any terminal connection.

PT100 Sensor Connections

- The PT100 sensors must have 1 white, 2 red output lines. (DIN 43760, IEC 751)
- Ch2 channel should always be connected to the middle column of the MV transformers.
- The Ch4 channel can be connected to measure the ambient temperature of the traction core or to OFF.

The characteristics of the cables that transmit the Pt100 measurement signal should be as follows:

- It must be separate from the power cable
- Transmission Cables must be spiral and surrounded by a protective shield
- Section must be at least 0.5 mm²
- It should be fixed firmly to the terminals
- It should be as silver conductor



NOTE: Using cables that do not meet the above specifications may cause abnormalities during temperature reading. It should be noted that any parasitic noise in the signal lines may cause anomalies in the Pt100 inputs (CH1-CH2-CH3-CH4) or in the sensors themselves.

Temperature Sensor Errors

In case of failure or at least one of the PTC100s connected to the measured temperature value exceeds the full scale value, the energy of the FAULT relay is cut off, where visual and audible warnings enter. In the meantime, the device will display the corresponding channel error on the screen.

Short Circuit: means that the sensor cables are in contact with each other, or that the device temperature measurement falls below the minimum scale value of -10 ° C.

Open Circuit: means that the sensor cables are open or the device temperature measurement exceeds the maximum scale value of 250 ° C.

Press the **Reset** button that appears on the screen to energize the Fault relay and remove the fault. This button is used for the Silent Error Alarm, in which case only the fault relay is energized again, the acoustic warning is silent. However, the error continues to be displayed on the screen.

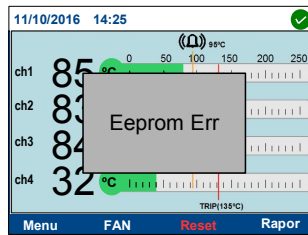
- To remove the fault from the center, check the Pt100 connections and replace the faulty sensor.

Refer to section 3.7 SETTING FAULT SETTING for the error that will occur as a result of activating the Fault Setting function in Settings.

NOTE: Exceeding the minimum / maximum scale value can result from interference in the sensor lines; In this case, the sensors and all extension cables must be installed correctly. (See the Measurement Signal Transfer paragraph)

Data Recording Error

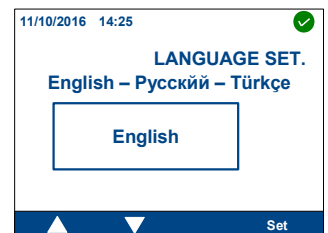
If the internal memory fails, the FAULT relay position changes and the main display shows warning. You can press the resulting **Reset** button to remove the fault from the screen. In this case, the most recently programmed parameters remain the same and can not be changed. To check if the memory is working properly, turn off the device and turn it on again. If the same error is encountered, send the device to KANEL Mühendislik Ltd. to be repaired.



COMMISSIONING

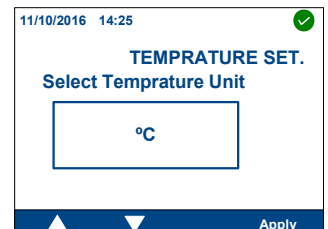
1. Step: Choice Of Language

The next screen will appear when it is first activated. Up, Down buttons to select one of the Turkish, English or Russian language and press **Set** button. After the language option is stored in the memory, the device starts to work on the selected hotplate and then goes to the 2nd step Temperature setting section.



2. Step: Selection Of Temperature Unit

With the Up and Down buttons on the bottom line, one of the temperature units Celsius (°C) or Fahrenheit (°F) is selected and the **Apply** button is pressed. In this case, if OK is pressed, the change is recorded. If you want to change it, press the **Back** key



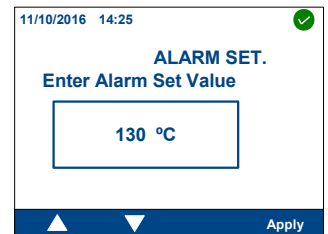
3. Step: Channel 4 (ch4) Operating Status

By using the Up, Down arrow buttons, the 4th sensor will be set to On (running) or Off (disabled), and it will be set to work and then the **Apply** button will be pressed. In this case, if **OK** is pressed, the change is recorded. If you want to change without recording, press **Back** button.



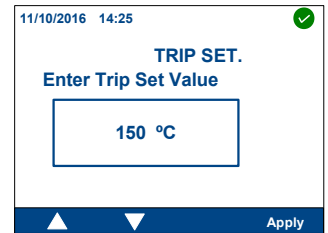
4. Step: Entering Alarm Value

You can set Alarm Temperature Set value by Up, Down buttons. Then click the **Apply** button. In this case, if **OK** is pressed, the change is recorded. If you want to change without recording, press **Back** button.



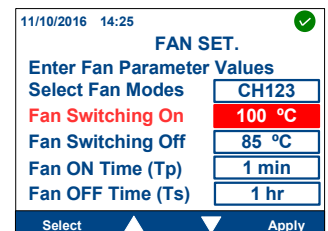
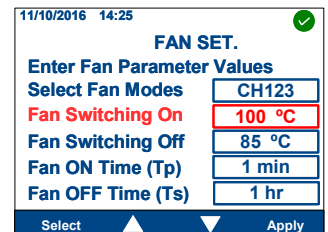
5. Step: Entry of TRIP Alarm Value

The temperature set point for TRIP should be higher than the Alarm temperature setpoint. The desired temperature value is set via the arrow keys. Then click the **Apply** button. In this case, if **OK** is pressed, the change is recorded. If you want to change without recording, press the **Back** key.



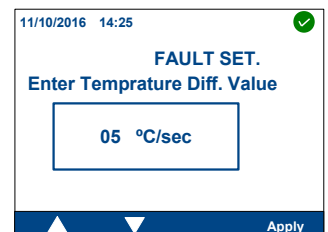
6. Step: Selection of Parameters for Fan Study

There are five parameters for the fan setting. Fan start temperature value must be higher than Fan stop temperature value. The cursor keys move to the desired setting and then the Select key is pressed. In this case, the background color of the setting parameter is red, and the font color is white. With the Up and Down arrow keys, the parameter setting is set to the desired value and then the Back key is pressed. For each parameter, you can switch between parameters using the Select and Back keys. After the parameters are set, the Apply button is pressed for recording. In this case, if OK is pressed, the change is recorded. If you want to change without recording, press the Back key.



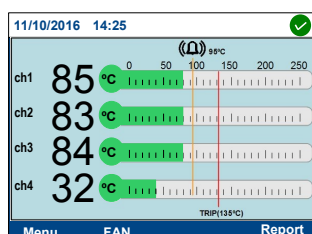
7. Step: Determination of Instantaneous Increase of Temperature Value

With the arrow keys, Instantaneous Temperature Increase Value is set to the desired position. It refers to the temperature rise value in the room. If it is desired to turn this feature off, the parameter is set to OFF. Then click the **Apply** button. In this case, if **OK** is pressed, the change is recorded. If you want to change without recording, press the **Back** key. After recording, the device starts to operate normally.

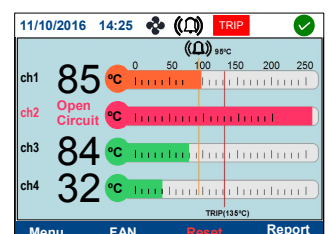


MAINPAGE

Users can see the most needed temperature values, Manual Fan, Silent Alarm, Alarm, Trip, Fan and Error conditions on this screen at the same time.



System
Normal

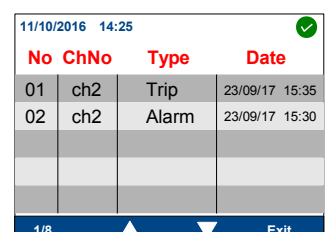


REPORT

It records and displays the faults and alarms that occurred during the operation of the device. There are 40 recording memories and when the recording memory is exceeded, the first recording is deleted and a new recording is made.

Report records :

Fault(sudden temperature change) fault,
In the form of Alarm and Trip. Arrow keys switch between the pages. When **Exit** button is pressed, return to homepage is made.



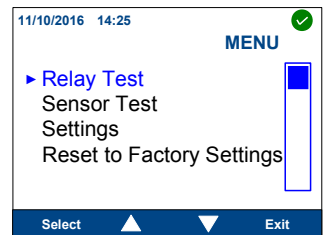
No	ChNo	Type	Date
01	ch2	Trip	23/09/17 15:35
02	ch2	Alarm	23/09/17 15:30

MENU

Control of the contacts of the output relays, detailed testing of the operating states of the sensors and general settings where the settings are made. The parameters in the menu can be accessed with the arrow keys and enter into the setting or test section with the **Select** button and exit with the **exit** or **cancel** button

NOTE-1: If the password is activated, then settings section is entered by the password.

NOTE-2: When entered in the Menu or Report section of the homepage, it will automatically return to the Homepage screen if it any button was not clicked for 2 minutes.

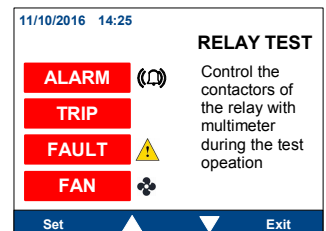
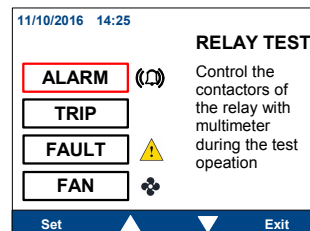
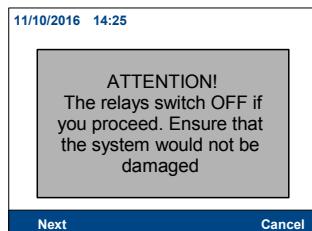


1. RELAY TEST

It gives the warning message on the side before entering this section. If the **Continue** button is pressed, the RELAY TEST section is entered. In this case, the operation of the device is stopped. ALARM, TRIP, FAULT, FAN relays go to OFF position. The up and down arrow keys are used to switch between relays and the relay position changes each time the **SET** key is pressed. **Exit** button will exit this page and return to Menu page.



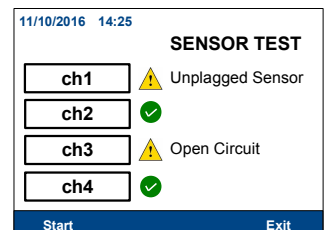
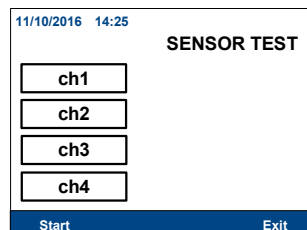
Never enter the Relay Test Area while the device is connected to the system. System and device may be damaged.



2. SENSOR TEST

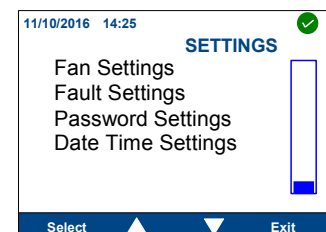
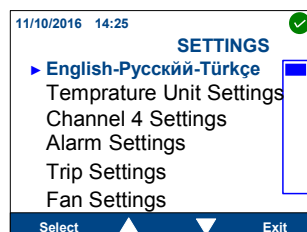
The sensor test tests the operating states of the sensors and if an error exists it displays the error.

The result of the test is an open circuit. A closed circuit, an **OK** signal which means that is not plugged in and that there is no fault. Test start with **Start** button and it is completed between 20-30 seconds. Operational statuses are shown next to the channel numbers. **Exit** button will exit this page and return to Menu page.



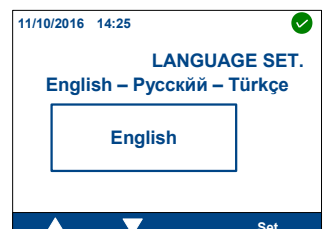
3. SETTINGS

This is where the settings related to the device are made. It is entered with password. Language, Temperature Unit, Channel 4, Alarm, Trip, Fan, Fault, Password and Date-Time can be set respectively.



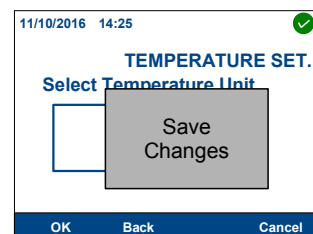
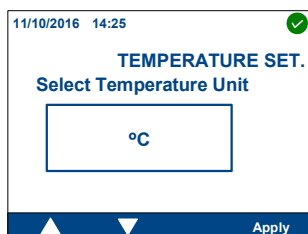
3.1 LANGUAGE SELECTION

Available in Turkish, English, Russian languages. This can be selected when the unit is first powered on, or it can be entered and changed later.



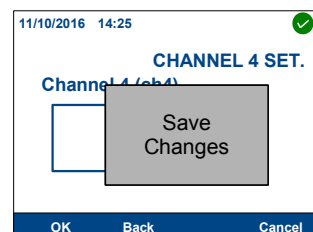
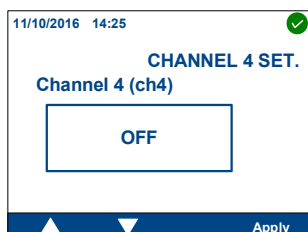
3.2 TEMPERATURE UNIT ADJUSTMENT

The temperature unit can be set to Celsius(°C) or Fahrenheit(°F). The system changes the settings according to the selected temperature unit and displays the temperature values according to that unit. The temperature display on the main screen and the temperature values required for operation of the device are made according to this selected parameter.



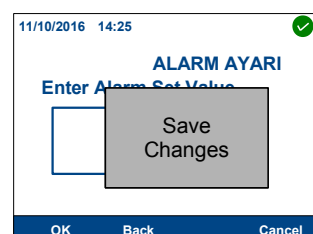
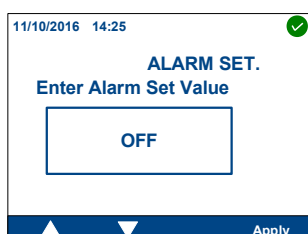
3.3 Channel 4 Option

Channel 4 (CH4), sensor number 4 can be used for different purposes. It is possible to measure the temperature of the transformer core, to measure the ambient temperature, to operate the fan according to this sensor. The parameter must be set to On in the setting menu for activation. If not, it should be selected Off.



3.4 ALARM ADJUSTMENT

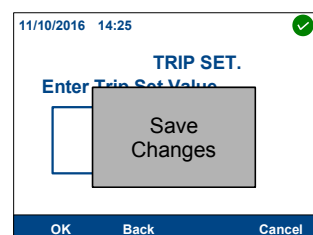
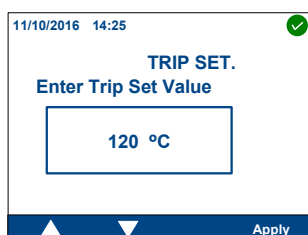
If any of the sensors exceeds the set temperature set in this section, the ALARM relay is energized after 5 seconds and the alarm log is displayed on the notification screen. When this happens, the date-time and channel information are stored in the memory and can be viewed in detail from the report screen.



In the case of an alarm, the temperature value on the scale of the relevant channel on the main screen is shown in red. If the temperature value measured from the corresponding sensor is equal to or lower than the set alarm temperature setpoint, the alarm of the ALARM relay is deactivated and the alarm log is removed from the notification screen. You can also use the **Reset** button to activate the Silent Alarm function and quickly cut off the power of the relay. However, the alarm log is displayed on the screen until the temperature value falls below the set value.

3.5 TRIP (On) SETTING

If any of the sensors exceeds the set trip temperature setpoint in this section, the TRIP relay is energized immediately and the message TRIP appears on the notification screen. When this happens, the date-time and channel information are stored in the memory and can be viewed in detail from the report screen. The temperature value of the relevant sensor on the scale of the main display is shown in orange. If the temperature value measured from the corresponding sensor is equal to or lower than the set trip temperature setpoint, the TRIP relay is de-energized and the TRIP input is removed from the notification screen.



3.6 FAN ADJUSTMENT

There are 5 parameter options for fan :

Fan Modes: Indicates the mode required for fan operation.

OFF: The fan relay is deactivated and the fan does not operate. It can only be operated manually.

CH123: Fan relay operates according to temperature sensors Ch1, Ch2, Ch3.

CH4: If channel 4 setting parameter (Ch4) is on, the fan relay operates according to Ch4 temperature sensor.

Fan Start Value: The temperature, at which the fan relay is energized, is the set value. It should be higher than Fan Stop value.

Fan Stop Value: The temperature value, at which the fan relay will be deactivated after, is energized.
Fan ON Time (Tp): Set in minutes. It can be selected from 1-30 min or OFF can be selected and this feature can be canceled.

Fan OFF time (Ts): Set in hours. You can choose from 1 to 24 hours. Tp and Ts times remain energized during the fan relay Ts at the end of each Tp period if the temperature value on the sensors has exceeded the Fan Stop value and the Tp parameter is not selected as OFF.

The aim here is to save the energy by starting the transformer cooling, which starts to increase in temperature, by operating the fan in short time steps. If the temperature exceeds the Fan Start value, this feature is disabled until the temperature value falls below the Fan Stop value. Saving mode automatically activates if the temperature rises above the Fan Stop value.

11/10/2016 14:25

FAN SET.

Enter Fan Parameter Values

Select Fan Modes **CH123**

Fan switching On **70 °C**

Fan switching Off **60 °C**

Fan ON Time(Tp) **5 min**

Fan OFF Time(Ts) **1 hr**

Select ▲ ▼ Apply

11/10/2016 14:25

FAN SET.

Enter Fan Parameter Values

Select Fan Modes **CH123**

Fan switching On **70 °C**

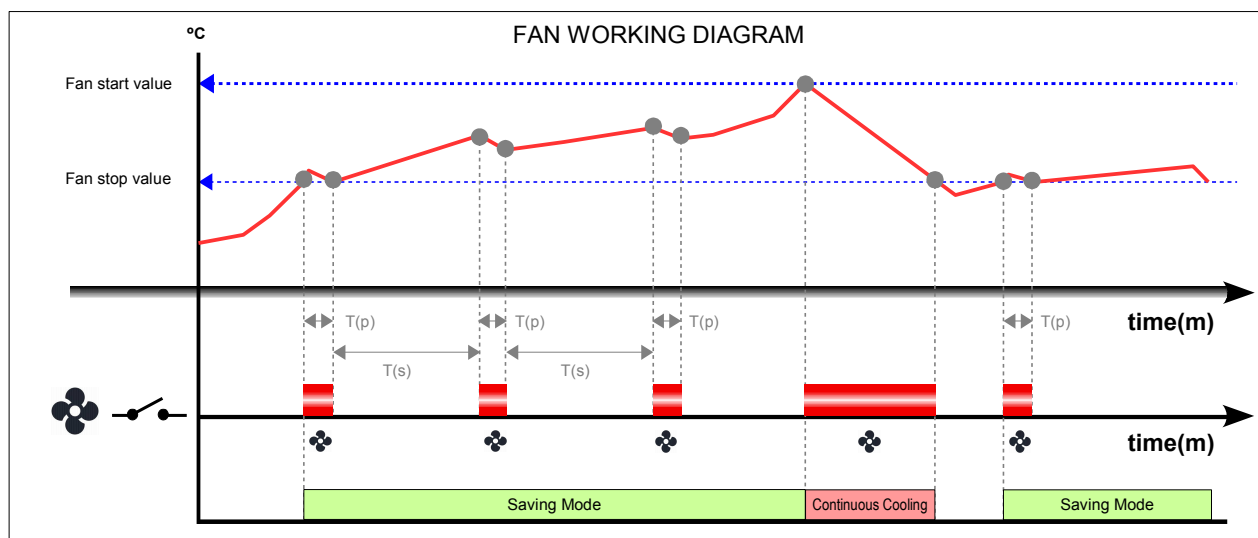
Fan switching Off **60 °C**

Fan ON Time(Tp) **5 min**

Fan OFF Time(Ts) **1 hr**

Save Changes

OK Back Cancel



3.7 FAULT (instantaneous Temperature Increase)

Instantaneous temperature increase analyzes the temperature rise (ΔT) value in seconds ($^{\circ}\text{C}/\text{sec}$).

The user can choose from 1°C to 30°C (ΔT). To turn off this feature, this parameter must be set to OFF in the setting section. If the calculated ΔT value is higher than the value set by the user, the device inhibits possible ALARM, TRIP and FAN conditions and energizes FAULT relay. The display shows the calculated ΔT value for the relevant channel. The device will continue to operate normally when the Reset button on the screen is pressed to remove the resulting error.

If the device is to be operated by connecting it to the windings of high-power electric motors, it is recommended that ΔT to be set between 20°C and 30°C . This is because the instantaneous temperature increase (ΔT) of the end of a running motor rotor load can occur.

11/10/2016 14:25

FAULT SET.

Enter Temperature Diff. Value

05 °C/sec

▲ ▼ Apply

11/10/2016 14:25

FAULT SET.

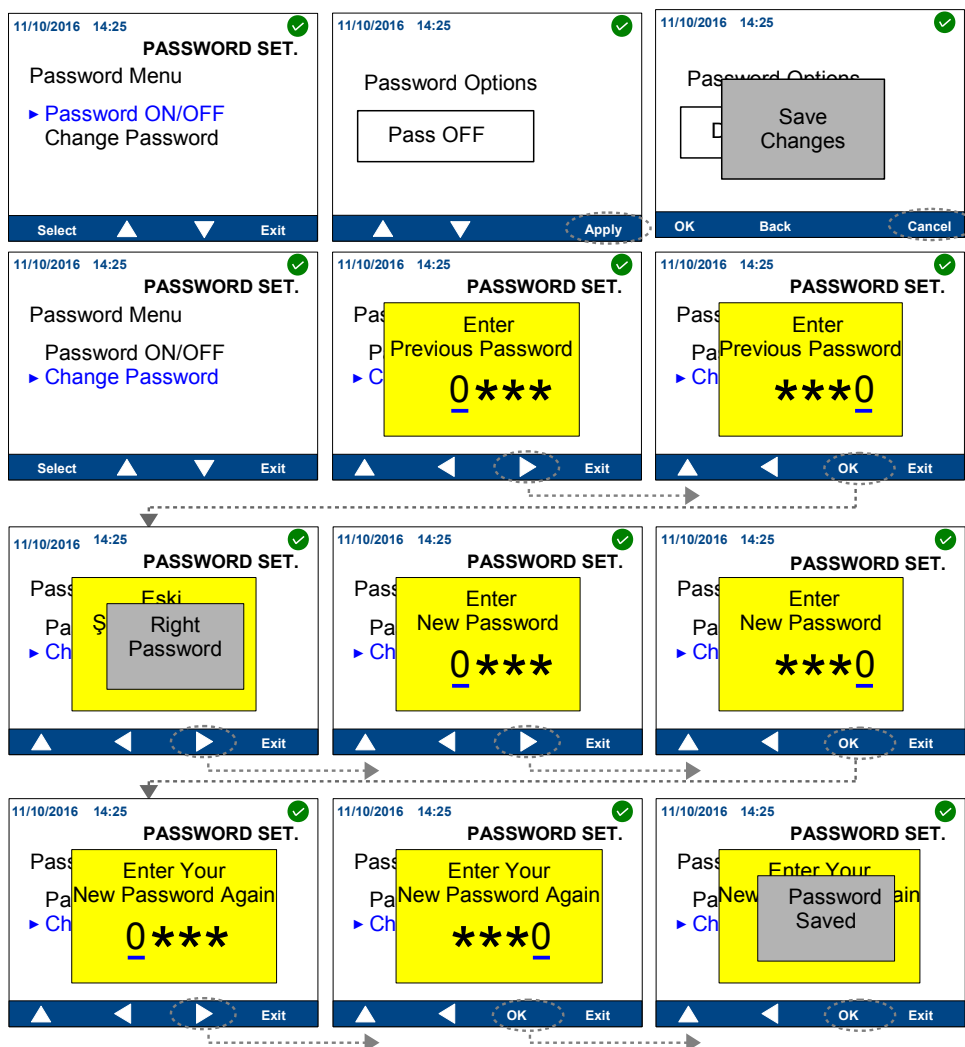
Enter Temperature Diff. Value

Save Changes

OK Back Cancel

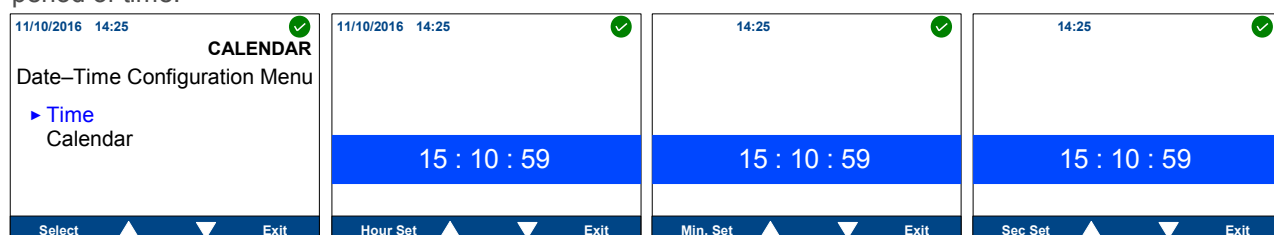
3.8 PASSWORD ADJUSTEMENT

This is the section that is entered to change the password or enable or disable the use of the password. The factory default value is 0000. First of all, the former password shall be entered correctly. The numeral value of the digit where the blue bottom line exists is entered by using up key. The next digit is reached with the right key. Similarly when values of all digits are entered press OK key. If the former password is entered correctly a new section for the user to change the password appears. Similarly the new password is entered twice. If both passwords match, password saved message appears on the screen. When OK is pressed, new password is saved.

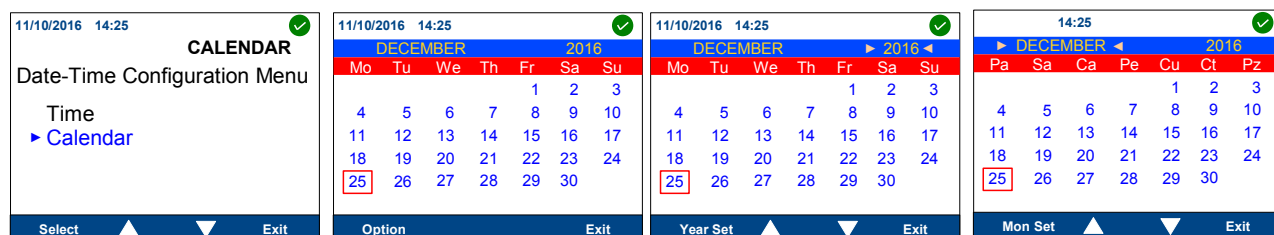


3.9 DATE – TIME ADJUSTMENT

Correctness of the measurements and reportings saved is only possible by correct entry of the real hour and date data in the device. When the device is out of power the real time works correctly for 7 days. Make sure to check the correctness of the hour-date data of the device which was out of power for an extended period of time.



Press SETTINGS to enter hour. First, set the hour value by pressing ▲ and ▼ keys and press set key. Thus, minutes section will appear. Do the same and press set key.

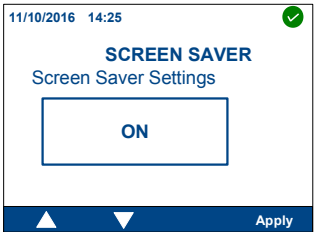


Choose SETTINGS to set the calendar. First set the year value by pressing ▲ and ▼ keys and press set year key. Thus, month section appears. Similarly set the current month and press set month key. Finally, day section of the device appears. Here choose the day and press set day key and exit settings menu. New date and hour information set appear on the top line of the screen.

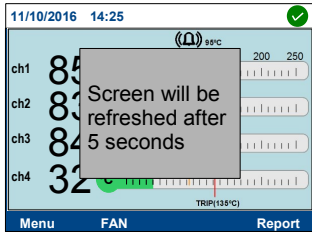


3.10 SCREEN SAVER

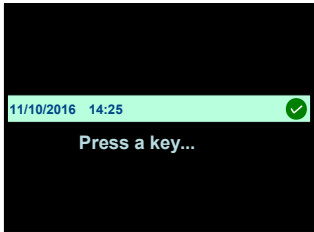
Used to activate the screen saver or to change to the automatic screen protection mode. Choose one of the ON/OFF options by using the Up/Down buttons and press the Apply button. If the OK button is pressed, all changes will be saved into the memory. To discard the changes made, press the Back button. If Screen saver is running in the ON mode while screen shows the Mainpage, then the screen saver is activated after 5 minutes later and only the status bar is shown on the screen. If the screen saver is running in the OFF mode, the screen will refresh itself every 5 minutes automatically.



OFF Mode



ON Mode



4. FACTORY SETTINGS

If you press return to factory settings, the device returns to its original settings. The Language, Temperature Unit, Channel 4, Alarm, Trip, Fan, Fault settings are entered in order.

 Date and time should be checked.

NOT1: The password is reset.

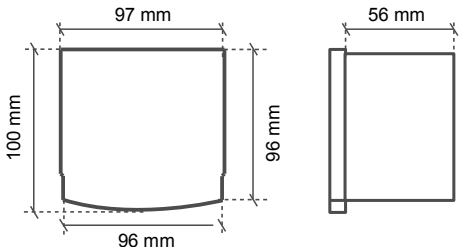
NOT2: After a few seconds of pressing the return to factory settings button, it will be directed to the opening screen

Temperature Unit	: °C
Channel 4 (Ch4) Setting	: off (disabled)
Alarm Set Value	: 130 °C
Trip Set Value	: 150 °C
Fan working mode	: CH123
Fan Start Value	: 100 °C
Fan Stop Value	: 85 °C
Fan ON time (Tp)	: 1 minute
Fan OFF time (Ts)	: 1 hour
Fault (ΔT) Temperature Change Value	: 5 °C/s
Password Usage	: off (disabled)
Date – Time	: Must be set.

Technical Specifications



Operating Voltage (Un)	: 24.... 240 VAC / DC (±10%)
Operating Frequency	: 50/60 Hz
Supply Power Consumption	: < 5VA
Relays (4 pieces)	: max.16A/240 Vac
Screen	: 2,4" color TFT
Device Protection Class	: EN 60529 IP 40
Terminal protection class	: IP 00
Accuracy	: ±1% fully scale ±1 digit
Sensor Type	: RTD sensor, Pt100 type, 3 wire (max. 1.5mm ²)
Ambient Temperature	: - 20 °C + 60 °C
EMC - Immunity	: EN 61000-6-2
EMC - Emission	: EN 61000-6-3
Installation Type	: to panel cover from front
Dimensions	: 96x96x56 mm



Application

- 3 **PT100-KS** signal conductors must be connected to the distribution box (**BOX-KS**) without terminal connection and considering the distance to be protected from high voltage. Sufficient length and thickness provide adequate insulation for transformer coil wires.
- In the distribution box 3 conductors of each PT100 sensor must be connected to the PT100 sensor inputs of the **TC-PT100** temperature controller with a minimum 0.50 mm² cross section, a maximum of 1 mm².
- The cable shield used for each sensor should be grounded only from the nearest point to the **TC-PT100** temperature controller side. The other end should remain open.
- To avoid sensor errors signal sensor cables must not be near medium-voltage cables and must be laid in a linear way, without creating windings on itself.

